

a first signal generator for generating an alarm signal when the total number of
defects in a specific one of the core classes is about equal to or greater than a first
predetermined number.

REMARKS

Claims 1-3, 6-20, 23-38 and 40-60 are pending in the application. Claims 1, 18, 25 and 37 have been amended. Claims 4, 5, 21, 22 and 37 have been cancelled. Claims 9-17, 26-34 and 49-60 have been withdrawn from consideration.

Pursuant to the Examiner's restriction requirement, applicants hereby confirm the election of Group I, claims 1-8, 18-25 and 35-48 for prosecution in this application, made by Applicant's attorney, Michael A. Messina, in a telephone interview with the Examiner on June 2, 2000.

In the Office Action, claim 25 was objected to because it was underlined. The underlining has been deleted. Applicants believe this amendment is fully responsive to the Examiner's concerns.

Claims 1, 2, 6, 18, 19, 23, 37, 40 and 41 were rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent 5,801,965 (Takagi). Claims 1, 3, 6, 18, 20 and 23 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent 6,047,083 (Mizuno). Claims 3-5, 7, 8, 20-22, 24, 25, 35, 36, 38, 39, 42, 46 and 47 were rejected under 35 U.S.C. §103(a) as being unpatentable over Takagi in view of U.S. Patent 5,814,829 (Broude). Claims 43-45 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Takagi and Broude and further in view of U.S. Patent 5,591,971 (Shahar). Claim 48 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Takagi and Broude and further in view of U.S. Patent 5,960,106 (Tsuchiya). These rejections are respectfully traversed. Applicants

respectfully request reconsideration and allowance of the claims in view of the following arguments.

The present invention relates to a method and apparatus for automatically classifying a defect on the surface of a semiconductor wafer into one of, e.g., seven core classes: a missing pattern on the surface, an extra pattern on the surface, a deformed pattern on the surface, a particle on the surface, a particle embedded in the surface, a particle and a deformed pattern on the surface, or craters and microscratches on the surface. The defect may also be further classified into a subclass of arbitrarily defined defects defined by the user or preprogrammed in the apparatus. Embodiments of the present invention include using a scanning electron microscope (SEM) capable of collecting electrons emitted from a plurality of angular sectors to obtain an image of the defect and a reference image containing topographical and location information, then analyzing this information to classify the defect. As the defects are classified, counts are maintained of the number of occurrences of each type of defect, and an alarm is raised if the defect count in a particular class exceeds a predetermined level. Thus, defects are accurately and reliably classified and monitored to enable early detection and cure of processing problems.

Regarding the anticipation rejections based on Takagi and Mizuno, independent claim 1 has been amended to incorporate all the limitations of dependent claims 4 and 5, independent claim 18 has been amended to incorporate all the limitations of dependent claims 21 and 22, and independent claim 37 has been amended to incorporate all the limitations of dependent claim 39. Consequently, claims 4, 5, 21, 22 and 39 have been cancelled. As pointed out at pages 7 and 8 of the Office Action, Takagi does not disclose the limitations of claims 4, 5, 21, 22 and 39. Likewise, Mizuno does not disclose the limitations of these claims. Therefore, neither Takagi nor Mizuno anticipates amended independent claims 1, 18 or 37, or claims 2, 3, 6, 18, 19, 20, 23, 40 and 41, which depend from claims 1,

18 and 37, because they do not disclose each and every element of those claims. Thus, the anticipation rejections should be withdrawn.

Regarding the obviousness rejection of dependent claims 4, 5, 21, 22 and 39, now incorporated into independent claims 1, 18 and 37, it is contended at page 7 of the Office Action that it would have been obvious to combine Takagi's defect classification technique with Broude's teaching of counting defects and generating a signal when a threshold number of defects of a particular type are found, to thereby yield the invention of claims 4, 5, 21, 22 and 39.

Applicants disagree, and submit that a skilled artisan would not have been motivated to add Broude's teaching to Takagi's system as suggested by the Examiner. The purpose of Takagi's semiconductor device defect classification system is to extract feature data of the defects based on their classification, feed back this information to improve the automatic inspection process, use this information to determine the cause of the defects, and control the manufacturing machinery accordingly, to avoid further defects and improve yield. These functions are explained in Takagi at, for example, col. 5, line 27 to col. 6, line 9 with reference to Fig. 1.

Tagaki's purposes would not be furthered by Broude's defect counting and signalling technique. Broude relates to a photolithographic mask (or "reticle") inspection system wherein when a threshold number of reticle defects of a particular size is exceeded, the inspection is interrupted and the operator informed, so that time is not wasted continuing inspection of a low-quality reticle (see, e.g., col. 5, lines 47-67). In other words, Broude's system is for efficiently discovering and rejecting reticles that do not meet predetermined quality standards.

Broude's approach to inspection is much different (and more primitive) than Tagaki's, and is used in a different context. Broude's technique is for inspecting masks before they are

used in production to weed out low-quality masks (i.e., a "go -no go" test). In contrast, Tagaki improves product yield during production by using defect feature data from the inspection process to improve its inspection process, to determine the cause of the defects, and to adjust the operating parameters of its manufacturing machinery to prevent further defects. None of these functions are performed by Broude's inspection methodology, and none of Tagaki's goals would be served by modifying it with Broude's defect counting and display/inspection shutdown technique. Therefore, a skilled artisan would not have been motivated to add Broude's defect counting and display/inspection shutdown technique to Tagaki's inspection system to yield the invention of amended claims 1, 18 and 37.

It is stated in the Office Action at page 8 that a skilled artisan would have been motivated to incorporate Broude's counting and display features into Tagaki's system to enable the operator to stop or to slow down the process to improve yield. However, there is no support in either reference for this contention. As discussed above, Broude teaches counting defects, displaying the results and shutting down the inspection process to reject a low-quality reticle, not to improve manufacturing yield. Broude's process is not used for in-process inspection, where yield is an issue, but rather is used before production begins.

Moreover, stopping or slowing down the process to improve yield is not taught or even suggested as a desirable action in Tagaki. Rather, Tagaki arguably teaches away from such action by teaching the use of its inspection results to determine the causes of defects and to adjust the production parameters accordingly, thereby improving yield. Furthermore, Tagaki teaches selecting and segregating defective products for repair by an automatic or manual "repair unit" (see col. 6, lines 39-59). Tagaki's production line does not need to be slowed or stopped, as suggested in the Office Action, since Tagaki teaches an alternative technique for dealing with defective products. Such action would defeat the purpose of Tagaki's automated inspection/repair/process control system. Thus, the statement in the

Office Action offered to show motivation to combine Tagaki and Broude to yield the claimed invention is speculative, and cannot support a rejection under 35 U.S.C. § 103.

Consequently, amended claims 1, 18 and 37 are patentable, as are claims 2, 3, 6, 7, 8, 18-20, 23-25, 35, 36, 38 and 40-42, which depend from claims 1, 18 and 37.

Regarding the rejection of independent claim 46 based on Tagaki and Broude, neither cited reference teaches or suggests the important recited step of imaging with both an SEM and an optical imager. Both references teach optical imaging only, and do not mention SEM imaging or the claimed combination of SEM and optical imaging. See Tagaki col. 15, line 15 et seq. and Fig. 19; Broude col. 6, line 29 to col. 8, line 32. Since neither reference teaches or suggests the above-discussed SEM/optical imaging step of claim 46, any combination of Tagaki and Broude, however made, would still be missing this step, and it would not have been obvious to add this step to any Tagaki/Broude combination.

Consequently, claim 46 is patentable, as is claim 47, which depends from claim 46.

Regarding the obviousness rejection of dependent claims 43-45 based on Tagaki, Broude and Shahar, the Shahar reference does not furnish the necessary motivation to combine Tagaki and Broude to yield the apparatus of amended independent claim 37, from which claims 43-45 depend.

Consequently, claims 43-45 are patentable.

Regarding the obviousness rejection of independent claim 48 based on Tagaki, Broude and Tsuchiya, the Tsuchiya reference does not furnish a teaching or suggestion of the important step of imaging with both an SEM and an optical imager of independent claim 46, from which claim 48 depends, missing from Tagaki and Broude. Thus, any combination of Tagaki, Broude and Tsuchiya, however made, would still be missing this step, and it would not have been obvious to add this step to any Tagaki/Broude/Tsuchiya combination.

Consequently, claim 48 is patentable.

Reconsideration and withdrawal of the rejection of claims 1-3, 6-8, 18-20, 23-25, 35-38 and 40-48 under 35 U.S.C. §103(a) are respectfully requested.

Accordingly, it is believed that all pending claims are now in condition for allowance. Applicant therefore respectfully requests an early and favorable reconsideration and allowance of this application. If there are any outstanding issues which might be resolved by an interview or an Examiner's amendment, the Examiner is invited to call Applicant's representative at the telephone number shown below.

To the extent necessary, if any, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted

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